Invited Talk

Personal Digital Bodyguards
for e-Security, e-Health and e-Learning:
An International Journey

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Abstract

In the forthcoming years, the ubiquity of hand-held tablets and cell phones, along with their increased computing power and ergonomic data capture performances, will make it possible to convert these devices into Personal Digital Bodyguards (PDBs). PDBs will protect people’s sensitive data with signature verification, provide equipment use security with writer authentication, handwritten CAPTCHAs (e-security) and perform words spotting and recognition to monitor user fine motor control, which can detect stress, aging and health problems (e-health). In the hands of children, these tools will turn into toys helping them to learn and master their fine motricity and become better writers and students (e-learning).

At Scribens laboratory, we have been working on some of these potential applications for many years, directly or indirectly guided by the Lognormality Principle. In its simplest form, this fundamental premise states that the lognormality of the neuromuscular impulse responses is a basic global feature reflecting the behaviour of individuals who are in perfect control of their movements. As a corollary, if we specifically focus on the basic mathematical convergence toward lognormality, motor control learning in young children can be interpreted as a migration toward lognormality. Then, for the greater part of their lives, human adults take advantage of lognormality to control their movements. Finally, as aging and health issues increase, a progressive departure from lognormality is anticipated.

From a practical point of view, the concept of lognormality provides a common thread, an integrative standpoint to track the problems of signature verification, writer identification, handwriting generation, recognition and learning. This keynote presentation points out how the resulting methodologies could be of great help to meet the PDB challenge. It highlights which pathways we have decided to follow to reach this goal, where we stand now and what should be our next moves.

Throughout the talk, we call attention to the worldwide collective efforts that we have initiated over the years to track some specific problems, emphasizing the specific expertise of our national and international partners and putting these accomplishments in the context of the current state of the art. Actually, more than twenty (20) research teams from eight (8) different countries are working on various aspects of the PDB challenge. In e-Security, six (6) studies are going on signature verification (aging effects, stability analysis, system evaluation, performance enhancement through synthetic generation and reference minimization) and one (1) group works on handwritten CAPTCHA generation. In e-Health, six (6) studies deal with Parkinson disease, Alzheimer disease, cerebrovascular accident, under various experimental conditions. In e-Learning, regarding gesture analysis and handwriting recognition, three (3) investigations on gesture command generation are going on to improve human computer interfaces and two (2) teams use word synthesis to improve the recognition performances of their algorithms. Finally, three (3) groups are dealing with the kinematic analysis of graphomotor abilities in normal children, those with ADHD (Attention Deficit/Hyperactivity Disorder) and also those with mild traumatic brain injuries to improve the assessment of children with concussion.
The talk concludes by suggesting that this research program is the tip of an iceberg and disclosing potential extension to robotics, speech and arts through newly starting projects.

**Biography:** Réjean Plamondon is Professor at École Polytechnique, Université de Montréal, P.Q., Canada. Over the years, he has been involved in many pattern recognition projects, particularly in the field of on-line and off-line handwriting analysis and processing. His main contribution has been the development of a kinematic theory of rapid human movements which can take into account the major psychophysical phenomena reported in studies dealing with rapid movements. The theory has been found successful in describing the basic kinematic properties of velocity profiles as observed in finger, hand, arm, head and eye movements. Professor Plamondon has studied and analyzed these biosignals extensively in order to develop creative and powerful methods and systems in various domains of engineering.

Fellow of NIAS (1989), of IAPR (1994) and of IEEE (2000), Professor Plamondon has been involved in the planning and organization of numerous international conferences and workshops and has worked with scientists from many countries. He is the author or co-author of more than 300 publications and owner of four patents. He recently received the IAPR/ICDAR 2013 outstanding achievement award for “theoretical contributions to the understanding of human movement and its applications to signature verification, handwriting recognition, instruction, and health assessment, and for promoting on-line document processing in numerous multidisciplinary fields”.

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